Pathways

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ABOUT THIS ISSUE

During the course of the last year, I have been privileged to work with the staff and students of a school, helping them to set up a laboratory in which children could "experience" science. Simultaneously, a similar exciting experiment was going on at another Delhi school. This issue brings you reports on the functioning of these two projects. We hope it will stimulate many other schools to set up such rooms where children may get opprtunities for 'hands—on' work in science. The short-term effects—their enjoyment—are easily visible. The long-term effect - making them 'explorers'—is one that will have important consequences on the training of their minds.

Apart from that, you will find interesting craft work ideas and a project for pre-primary children. Homework—an unpleasant fact of life for both teacher and taught—can be made more interesting and stimulating. We hope you will get some ideas from our article.

Happy reading !

—Gayatri Moorthy

NEW APPROACHES IN SCIENCE TEACHING

by **Ilma Levine**

At Springdales School, Pusa Road, a new approach to teaching Junior Science has been undertaken during the past school year (1984-85). With encouragement and support from Mrs Kumar, the Principal, and guidance from Mrs Sundararajan of the Teachers Centre, a "hands-on" science program was initiated, with a science activities room as the focal point.

The underlying premise for the program is that children are naturally curious, and will respond to the opportunity to find out for themselves how things work. This kind of experience provides them with an excellent foundation for learning scientific principles.

The benefits of a hands-on science program are many, not only in terms of the subject matter of science but also with respect to critical thinking and creative problem solving. Young children often cannot grasp abstract concepts—the "why" of science. It is quite common for them to simply memorize the material in science texts, and to view demonstrations performed by the teacher without understanding what they see. We do not need or want to turn all children into scientists or technicians, but we must try to make the world more comprehensible to them. Even the youngest school child can be allowed to do activities that permit personal interaction with the laws of the physical world. Even more important is the freedom to explore, as the child wishes, without unnecessary direction or undue constraint. Education should not be the attempt to copy the work of other people, or the pursuit of neat answers to the questions someone else asks. We tend to ask only questions to which we know the answers ! Children should be taught to ask the questions—when they ask questions that are beyond our ability to answer, then we know that our efforts are succeeding. Our job, then, is to help them devise ways to find the answers.

It is, obviously, necessary to provide a space for activities to take place, but this space need not be large. Even a corner of a room can suffice, as long as numbers of children are limited so that each child has adequate space to work. The individualized aspect is important—the ability to do the work by oneself is critical. Fortunately, the cost of supplies and equipment is minimal. However, the success of this kind of learning experience depends primarily on the attitudes of the adults who work for and with the children. They need not be "teachers" in a formal sense, and need not have a specific background in science, but they must be themselves enthusiastic, intellectually curious, and able to work with children in a relaxed manner. Managing such a program demands not only physical energy, but also requires time to collect and maintain materials and to set up and clean up the activity area. These tasks are continuous and unrelenting. Most of all, time is needed, to plan and implement new activities as they are needed, and to respond to the individual interests and needs of the children. If the adults involved do not genuinely enjoy "messing around", the children will not be well served. With this in mind, careful planning is needed to insure success.

The Junior Science Activities Room was set up in a small classroom (about seven by seven metres). A sink was installed and storage shelves were added. Six desks serve as working tables; additional tables hold items of interest or needed materials. The tables are arranged informally, and there is space to move about the room freely. Ideally, no more than two children should work at these tables; though it is possible for four children to share a table for the more structured and group

oriented activities. Bulletin boards contain questions, puzzles and challenges as well as displaying charts and pictures. Appropriate living materials are kept (insect cultures, goldfish, a turtle, plants) and are enjoyed. They provide interesting activities, and help the children learn respect for living things. A list of safety rules and a list of room use suggestions are posted. Children are encouraged to think of the room as theirs and to make suggestions for its improvement. Supplies, materials and equipment are kept on shelves or in labelled containers, and are easily accessible. There are a number of small kits containing materials and suggestions for individual investigations.

The room was used during most of the year for fourth and fifth standard children. Groups of about twenty children used the room, with each group having one activity period each week. Activities were correlated with the science text and integrated with social studies and language instruction whenever possible. Math skills were incorporated into many of the activities. At each session, most of the work was done by the children themselves; demonstrations were kept to a minimum. There were follow-up classroom discussions, and children prepared written reports when appropriate.

During the final three months of the year, the sixth standard children came to the room, in groups of ten or twelve. Again each group come for one period each week. They were allowed to choose from a selection of science-related activities, and were encouraged to explore a variety of topics, not necessarily related to the science syllabus that was being followed in their regular science classes. Each child was required to select a topic at each session, and to enter the choice in a register. A change of selection was discouraged, though sometimes permitted. Informal files were kept by each child. The files were read and checked, but no grades were given. Children were encouraged to ask questions and to try to discover answers, without being held accountable for results. It was our intention to provide the opportunity for imaginative exploration while developing skills of problem solving, independent study and self discipline.

The informal atmosphere and hands-on approach brought a positive response from the children. Classroom teachers reported that children were more willing to undertake the less exciting aspects of science studies. However, it is too soon to make a realistic evaluation in terms of academic performance. Enthusiasm is genuine; there is no doubt about the fact that children have enjoyed their experiences and are eager for the program to continue But whether this will be a useful and practical addition to the school on a more permanent basis, at this time, remains to be seen. The immediate future of the program will depend on the availability of space and staff. Nevertheless, this past year has been a rewarding one-the experiment was a success !

Future plans : I am convinced that it is unrealistic to demand or expect classroom teachers to accept primary responsibility for doing hands-on activities with large groups of children. However, we plan to try to introduce a limited number of activities suitable for use in the classroom by one or two children at a time. This will entail providing fourth and fifth standard teachers with materials to put in a "science corner". At first, activities will be correlated with the syllabus. We hope to encourage teachers to gradually take an active role in developing and setting up these activities. I am sure that the science room will be used also, but the type and extent of use will obviously depend on who is in charge.

Readers might be interested in the following brief descriptions of some of the activities carried out in the Science Activities Room last year.

Cartesian Diver—Children were given a tall bottle, a plastic medicine dropper, some

paper clips to use as weights, and were shown an example of a functioning "diver". The challenge was to make a diver that would work, and most children found it quite difficult. We attempted to discuss and explain the scientific principles involved, but I found that this activity was most useful as an exercise in problem solving.

Center Of Gravity—This was simply a set of wooden figures that could be built into a variety of towers and pyramidal forms. It was a challenging activity-primarily problem solving.

Electromagnets—A straightforward, construction type activity, with directions for making an electromagnet using a large nail, bellwire, and 1.5 volt dry cells. Relationships between number of turns of wire and strength and between number of dry cells in series, and strength were investigated.

Kaleidoscopes—This was one of a series of mirror activities, and was understandably one of the most popular. The activity involved making a simple kaleidoscope, and included questions about angles of reflection, multiple images, etc.

Magnets—A variety of magnets were presented for open ended investigations. Questions were asked about location of poles, relative strength of magnets, identification of magnetic substances, etc. Iron filings, enclosed between plates of glass, were used to see lines of magnetic force. Children were encouraged to "invent" magnetic games.

Measuring, Weighing—This began as a result of requests on the part of children to use the balance scale. It was a large market-type scale with weights of 50,100,200,500 and 1000 grams. We started it as a problem solving activity (how could you weigh out 25 grams of something ?). Then we went on to make additional weights with plasticine. Following this, children could make small balance scales to take home. Materials used were small sticks, paper clips, and cardboard cups fabricated by the children.

We introduced the concept of "mass" and tried to use that term instead of "weight". Logical extensions of the activity would be using and making spring type scales.

Mirrors—A series of activities based on mirror images using one mirror and then using two mirrors. This included measurement of angles and work with symmetry.

Model Aeroplanes Copying cardboard models, painting them, and assembling them. Children were allowed to take the results home, and this was popular, though not especially challenging. Another problem solving, construction activity.

Parachutes—Making and playing with small, toy parachutes. An outgrowth of air activities done with fourth standard children and adopted by sixth standard children.

Puzzles—Jig saw puzzles were very popular with a few children, and they displayed a great deal of patience in working on some difficult puzzles. This activity also provided lessons in cooperation. As an additional activity, some children made puzzles, and we also found a puzzle that involved a printed set of dinosaur bones that could be cut out and assembled. Multiple copies were made, and children could take this home to do if they wished.

Shadows— A variety of indoor and outdoor activities involving direction of shadows, size of shadows, shapes of shadows, multiple shadows, coloured shadows.

Sinking And Floating — A seemingly elementary activity that exposed some misconceptions on the part of sixth standard children, and proved to be quite absorbing.

Simple Circuits — A rather carefully sequenced set of activities that began with a battery (dry cell), a bulb, and a strip of aluminium

foil, and continued with a variety of conductors and non-conductors. After the concept of a simple circuit wes understood, switches were made, series and parallel circuits compared and various "Braino" type games made by the children. Very popular—mostly problem solving.

Siphons—Buckets and plastic tubing and water provided a lot of fun and a lot of learning, both of a problem solving and a conceptual nature. Almost all the children said they "knew" about siphons; almost all the children were unable, at first, to successfully use a siphon. Using coloured water adds excitement.

Solar Motors—A construction and problem solving activity that results in the making of an air convection motor that works either in the sun or with another source of heat. Components are empty tins, tape, black paint, corks, pins, paper, small snap fasteners and clothes-pegs. Children who brought in materials could take the finished products home.

Static Electricity — Investigations of static electricity using plastic drinking straws, rubber combs, small pieces of thermocole, grains of rice, plastic bags, wool, silk, balloons, etc. The series of activities were sequenced and involved following specific and detailed directions.

Straw Structures — Making geometric shapes, towers and bridges from pieces of drinking straws and straight pins. Inherent in the activity was an investigation of how best to incorporate strength and rigidity into the structures.

Surface Tension—"Floating" needles on water, discovering the effect of soap on surface tension, etc.

Tangrams—A puzzle type activity that most children avoided but a few were fascinated by. Basically problem solving.

The following gives you an idea of the kind of equipment used by the children.

PERMANENT EQUIPMENT

Balance scale	Metre sticks	Buckets, basins, tubs	Mirrors
Hot plate	Spirit lamps	Kettle	Thermometers
Magnets	Tool kit, scissors	Magnifying lenses	Torch

(Laboratory glassware and tripod stands are occasionally useful but not essential.)

MATERIALS AND SUPPLIES (purchased and acquired)

Balloons	Rubber bands	Marbles	Droppers
Candles	String	Plasticine	Nails, screws
Clay	Tubing	Seeds	Paper clips
Drinking straws	Batteries, bulbs,	Thermocole	Plastic cups
Jars, bottles	Bellwire	Wire	Steel wool
Paints, brushes	Cardboard	Cardboard tubes	Tins
Pins	Corks	Cotton	Wooden sticks, spoons

Assorted household chemicals as needed.

This is not a complete list, and not all the items on the list are necessary. It is often possible to improvise—tripod stands from tins, funnels from the tops of plastic bottles, pipettes from drinking straws. That is problem solving.

(M/s Ilma Levine has a Master's degree in biology from Cornell University, USA and was trained to teach biology and general science in high school classes. She has spent over ten years, in collaboration with a colleague, in planning organising and running a Science program which would give "hands-on" experience to children from pre-nursery classes to class 6. She is involved with the establishment of a Discovery Centre 'Cum' Museum in her home town and has spent the last two years at Springdales School setting up the Junior Science Activities Room described in the article above.

TEACHING RATIO IN THE PRIMARY SCHOOL

by **Jose Paul**

As part of my work, I conduct courses on mathematics for teachers of primary classes, where we try to clarify our own concepts of different aspects of the syllabus we are required to teach. One such topic that we deal with is 'ratio'—a proper understanding of which will serve children in good stead right until they leave school and also in their daily lives.

First let us remind ourselves of a few facts regarding this topic.

i. A ratio emerges when we compare two numbers for division. Thus the ratio of 3 to 4 is $\frac{3}{4}$ Note here that the order of the numbers is important. The ratio is between the first and the second number-in that order. Thus the ratio of 4 to 3 is $\frac{4}{3}$ and this is certainly not the same as $\frac{3}{4}$ (namely the ratio of 3 to 4).

ii. $\frac{4}{3}$ is the reciprocal of $\frac{3}{4}$

iii. The ratio of 5 to 6, namely $\frac{5}{6}$ is the same as the ratio of 10 to 12, namely $\frac{10}{12}$. In other word $\frac{5}{6} = \frac{10}{12}$, these are equivalent fractions. All equivalent fractions represent the same ratio.

iv. The ratio of two like quantities, that is, those measured in the same units, is a pure number.

If we compare two lengths, two weights, two areas or two volumes, their ratio is merely a number.

However, we sometimes compare, quantities measured in different units. Thus speed is $\frac{\text{Distance}}{\text{Time}}$, and acceleration is $\frac{\text{Speed}}{\text{Time}}$. These ratios will have to be given the appropriate units. They are denominate numbers,

v. $\frac{3}{4} = \frac{9}{12}$ Hence — 3,4,9,12, are called proportional

Here again the order or sequence of the numbers is important, and we can also say that 3 is to 4 as 9 is to 12.

Obviously, $\frac{6}{7} \neq \frac{8}{9}$. Hence 6,7,8,9 are not proportional.

From the two equivalent fractions that may be written using the given proportional numbers we can find any one missing number. We do this because the cross products of the two equivalent fractions are equal.

Thus : $\frac{1}{2} = \frac{6}{12}$ Hence $1 \times 12 = 2 \times 6$

$\frac{3}{4} = \frac{9}{12}$ and $3 \times 12 = 4 \times 9$

If we do not know one of the numbers; let us call it X.

Then, if $\frac{X}{7} = \frac{12}{28}$, $28X = 7 \times 12$ and $X = \frac{7 \times 12}{28}$

or $\frac{8}{X} = \frac{2}{36}$, $2X = 8 \times 36$ and $X = \frac{8 \times 36}{2}$

It would be wise to remember that all the ratio and proportion we have dealt with up to this point deals only with direct proportion. Inverse or indirect proportion is generally taught in the middle school and I will not deal with it in this article

Having stated all these facts, let us think about the many situations in which an understanding of this topic is useful to us in our daily lives. Giving examples of this kind, makes the subject more meaningful to the students. A knowledge of this will also help the teacher to develop on her own more examples for practice.

A. Pricing.

i. The amount of money paid is proportional to the number of articles purchased.

For example : Geetha bought 8 books for Rs. 56. Ram bought 12 books. How much did he pay ?

Using pure numbers we could write the following ratios :

$$\frac{8 \text{ books}}{12 \text{ books}} = \frac{\text{Rs. } 56}{\text{Rs. } X} \quad \text{or} \quad 8X = 12 \times 56$$

$$X = \frac{12 \times 56}{8} = \text{Rs.}84$$

The ratios could be written the other way around. We then get :

$$\frac{12 \text{ books}}{8 \text{ books}} = \frac{\text{Rs } X}{\text{Rs } 56}$$

The problem could be solved by using denominate ratios as well.

Either : $\frac{8 \text{ books}}{\text{Rs. } 56} = \frac{12 \text{ books}}{\text{Rs } X}$

Or : $\frac{\text{Rs. } 56}{8 \text{ books}} = \frac{\text{Rs } X}{12 \text{ books}}$

No doubt we teach this type of problem in early days as a part of the 'unitary method', but later on children can understand that they are based on ratios.

ii. The converse is also true.

The number of articles purchased is proportional to the amount of money spent.

eg. Shyam purchased 24 packets of crayons for Rs. 96. How many packets could Leela buy for Rs. 72 ?

B. Recipes provide common examples of simple proportion. Here is an example. 20 kg of rice can serve 100 people. How much rice will be needed to feed 40 people ? In other words, **the amount of food cooked is proportional to the number of servings planned.**

Medicines are often prescribed proportional to the body weight of a patient.

eg. If a 60 kg person is required to take 50 mg of a medicine, how much should a man weighing 90 kg take ?

C. Problems involving travel at a constant speed are also based on the idea of proportion. Here, **the distance travelled by the person or vehicle is proportional to the time taken.**

Thus : Shankar drives his car at a constant speed and travels 8 km. in 10 minutes. How long will he take to travel 36 km ?

The fuel used by the vehicle is also proportional to the time for which it travels.

eg. If a car uses 20 litres of petrol for a journey of 400 km how much petrol will it need for a journey of 700 km ?

D. Problems involving payments at constant rates.

i. The amount of commission received by a salesman is proportional to the quantity of the sales.

eg: Sita sells 60 tickets for a raffle and receives a commission of Rs. 5. Sonny sells 96 tickets for the same raffle. What commission did he receive ?

eg Sunil sells Rs. 3500 worth of goods and gets a commission of Rs. 1050. What will he get if his sales are Rs. 4200 ?

ii. Payment of simple interest is proportional to the principal, the rate of interest as well as the time for which the money is deposited.

All variations on the standard formula are based on the principle of ratio. Thus, if only one factor is varied at a time as shown below, each problem can be worked out using the method of ratios.

eg. The interest on Rs. 3000 for 1 year is Rs. 210. What is the interest on Rs 4500 ?

eg. The interest on a sum of money given at the same rate, is Rs. 350. What was the sum of money ?

eg. If the rate of interest paid on a deposit is 7%, what is the interest on Rs. 5600 ?

eg. If the interest paid on Rs. 7000 is Rs 840 what is the percentage rate of interest ?

E. Profit and Loss

As the percentage profit or loss is always compared to a cost price of Rs. 100, these problems also work out as examples or ratio and proportion.

Here are some examples :

i. A man buys a cycle for Rs. 550 and makes a profit of 8% on selling it. What is his actual profit ?

$$\frac{CP \quad Rs\ 100}{CP \quad Rs\ 550} = \frac{\text{Profit } Rs\ 8}{\text{Profit } Rs\ X} \qquad 100X = 8 \times 550$$

$$X = \frac{8 \times 550}{100} = Rs\ 44.$$

ii. A man buys a radio for Rs. 700 and sells it at a profit Rs. 63. If he bought another radio at Rs. 1200 and sold it at the same rate of profit, how much money (i.e. profit) did he make ?

$$\frac{CP \quad Rs\ 700}{CP \quad Rs\ 1200} = \frac{\text{Profit } Rs\ 63}{\text{Profit } Rs\ X}$$

$$700X = 63 \times 1200 \qquad X = \frac{63 \times 1200}{700} = Rs\ 108$$

F. **Conversion of given figures from one unit to another,** may also be considered as a ratio. Herewith some examples

i. Convert Rs 5 60 into paise

$$Re\ 1 = 100\ p$$

$$\frac{Re\ 1}{Rs\ 5.60} = \frac{100}{X} \qquad X = 100 \times 5.60 = 560$$

ii. Convert 20 m/s into km/hr

$$\frac{20\ m.}{X} = \frac{1\ s}{3600\ s\ (1\ hr)}$$

$$X = 20 \times 3600 = 72000m = 72km$$

The answer will be 72 km/hr.

G. Similar Triangles.

In two similar triangles the sides are proportional to each other—taken in the same order.

eg. Hari cut out a triangle from a piece of paper. Its sides were 9 cm 12 cm and 15 cm long. Anita wanted to make a bigger triangle, similar to Hari's. She had a larger piece of paper, whose largest side measured 25 cm. What will be the lengths of the other sides of her triangle ?

Obviously it would help children if they drew a figure before undertaking to solve this problem

Now the ratio of the bigger sides will be the same as that of the other two sides. Hence ;

$$\frac{15\ cm}{25\ cm} = \frac{12\ cm}{X\ cm} \text{ and } \frac{15\ cm}{25\ cm} = \frac{9\ cm.}{Y\ cm}$$

Calculating X and Y will give the lengths of the remaining two sides of the larger triangle.

H. The Measurement of the heights of building, trees etc using the method of shadows.

A flag post of 5m height casts a shadow 7m long. At the same time a nearby building has a shadow of 84 m. What is the height of the building ?

$$\frac{5\ m\ \text{height}}{X\ m\ \text{height}} = \frac{7\ m\ \text{shadow}}{84\ m\ \text{shadow}}$$

$$X = \frac{5 \times 84}{7} = 60\ m$$

Incidentally, this could form the basis of some interesting, yet very useful practical work in mathematics !

I. Scale Drawing.

The distances drawn on a map, sketch or plan are proportional to the actual distances of the places or objects Thus if the scale is $\frac{1}{100}$, it means that every 1 cm on the map represents 100 cm true distance. Scales are sometimes also given as 1 cm = 2 m, which means that 1 cm represent 2m distance in the section that is drawn.

Problems may be based on this. For example;

A distance of 500 km between two places A and B is shown by a distance of 4 cm on a map. What is the actual distance between towns C and D which are 7 cm apart on the map ?

While this list may not be exhaustive I hope readers will find it interesting and useful.

Active Science Learning In The Middle School

by Gayatri Moorthy

The Science Activity Centre at Sardar Patel Vidyalaya was set up in the summer of 1984 to involve children of the Middle School (Classes 5,6,7 & 8) in practical work which would give them opportunities.

i. to work with their own hands and acquire confidence in handling tools and materials,

ii. to carry out for themselves simple, improvised experiments using easily available, inexpensive material—in order to illustrate the facts/laws of science which they study in their theory classes,

iii. to observe some demonstrations-carried out by their teachers—of experiments which they cannot carry out themselves,

iv. to develop their skills of careful observation,

v. to develop skills of systematic and precise recording.

In the course of the past year, most of the work carried out in the Centre has been directly linked with the syllabus followed in the classroom. It is hoped that in the coming year, we will be able to involve a selected, small group of students-perhaps those who are members of the Science Club-in a few long-term projects and some open-ended activities which will develop their thinking and problem-solving skills further. Obviously these exercises will have to be carefully tailor-made to suit their age and development.

Budget

The initial investment covered the provision of ;

i. comfortable stools and tables around which the children could work in groups and a large table for the teacher—where, if required, demonstrations could be carried out. Provision was made for the storage of a gas cylinder under the teacher's table.

ii. storage cupboards and shelves, as well as a few shelves for the display of materials.

iii. bulletin boards both within the Centre and at its entrance.

iv. some conventional science equipment like glassware, thermometers, electrical equipment, microscopes, stop clocks, magnets, mirrors, metre sticks, slides; chemicals like acids indicators and other common reagents. Some of this equipment is used for demonstrations.

v. electricity and water supply. We propose to add gas supply and a burner, at the teacher's desk only, in the coming year.

vi. charts, models and preserved specimens which could be taken by teachers to the classroom, when needed.

The Centre has a stock of unconventional items like thread, string, rubber bands, balloons, paints, candles etc which are supplied to the students for their experiments. This stock has to be replenished as it is used up. A small number of selected chemicals are stocked for student use and for demonstrations. Stationery items like chart paper, various types of coloured paper, gum, felt pens, crayons are bought as needed-either for preparation of material to be displayed on the bulletin boards or for student experiments.

Apart from this budgetary provision for the salary of the teacher-in-charge has to be made. At a later stage, if the work of the Centre expands considerably, it would be useful to have a part-time laboratory assistant to help in the activities and maintenance of the Centre.

In the coming year we would like to add to our collection of models, slides and biological specimens, invest in some educational games and buy a few more items of scientific equipment. Provision has also to be made for replenishment of consumable items.

Personnel

One teacher is fully in charge of the Centre, apart from a light teaching schedule which keeps her/him in touch with what is going on in the classrooms.

Apart from this teacher, one member of the Science Department accompanies each class of children, when they come to the Centre once a week. Thus, at a time, there are two people to cater to the needs of approximately 40-45 students.

So far, however, correction of practical records has been the work of the teacher-in-charge of the Centre.

In the first year of the Centre's existence, this same teacher has managed jobs like taking out and putting away apparatus before and after classes. Occasionally, help has been sought from the assistants of the other laboratories, in the setting up of some demonstrations, or the purchase of material. When the activities expand further, it might be useful to have a part-time assistant to help with cleaning and maintenance work in the Centre and for outside work like the making of weekly purchases.

The Working of the Centre

Each class in the Middle School is allotted one period a week for work in the Centre. An attempt must be made to place this period next to a Science teaching period, so that, if needed the students can spend two consecutive periods in the Centre. They may then use the 'SAC Period' for theory in the next week. This degree of flexibility is important.

In the first year, the Centre has concentrated largely on getting students to perform the experiments which have been described in their own text-books. They use the Headway Science Series of Vikas Publishing House Pvt. Ltd. This is done with a view to helping the majority of them understand "science" better. Fortunately, many of these experiments, are based on improvised models etc and children have enjoyed carrying them out. Improvised experiments develop psychomotor skills in the handling of both materials and tools. Much learning takes place if an experiment does not work and the student has to find out why. The teachers normally try out the experiments in advance and are prepared for all possible difficulties. Throw-away items like empty tins, bottles etc are brought from home by the students. The Centre provides them with material like paper clips, wire, crayons, thread, matches, candles etc. Besides these experiments, the children have learnt to use thermometers and stop clocks, handle selected chemicals with care, use glassware like measuring cylinders, make simple slides to observe cells etc. Teachers have set up demonstrations like the preparation of oxygen gas and some biology experiments. Students have been most excited at viewing slides through a microscope. A list of experiments done in the first year is attached.

The bulletin boards have played an important role in the Centre They are, of course, used to display work done by the students. They also display scientific information of interest to students—written in simple language which they can read on their own. An important aspect of the display has been a continuous effort to provide the students with quizzes, ideas for simple experiments they can do at home and a variety of other interesting science activities. Some of our activities have been based on a study of the display-for example, class 6 was asked to look closely at a number of containers put up on display and then answer questions on weights and measures and methods of packing/sale. Crosswords and other puzzles worked out for the students have been tackled by the students in addition to their routine work. These are cyclostyled and made available to individual students.

A special shelf has been set aside for a display of interesting items like rocks or feathers collected by the students. These are put up with the student's name and a little information about the item.

Students record their work in practical notebooks. Our effort here is to get them into the

habit of making an honest record of what they actually observe and of making simple scientific deductions, where possible. The teacher usually puts up the format of this record on the blackboard in advance. It generally follows this pattern:

Activity No. and Title; Materials Needed: What I Observed; Conclusion.

Often one or two simple questions may be posed to help the student reach a conclusion or think out something on his/her own. Note that we have not asked students to write out any elaborate description of working procedures. The recording of some experiments is done by means of simple line drawings or sketches. In others, students are given an outline and taught how to put down readings in tabular form. Students are encouraged to write in their own words.

The excitement of coming to the Centre, making things with their own hands and watching them work has certainly made science learning more enjoyable for the children. Gradually they have got used to the idea and they now settle down and get to work promptly. The duration of their stay in the Centre (35 minutes) is sometimes a handicap and hence they are allowed to come in during certain other periods, with the permission of their class teacher.

The climax of year's activities was a small exhibition set up as a part of the Activity Week in the school. Children set up, demonstrated and explained to visitors some of the work they had done.

In the next year, we would like to expand the activities of the Centre somewhat. Classes 7 and 8 (of 1985) have got used to the idea of doing simple experiments. We hope that it will be possible to develop simple shoe-box kits which will contain materials and instructions for additional experiments. Interested students could select from these and carry out the experiments-either as a part of Science Club Activities or at home. We would like to include in these kits, additional experiments-some of them open-ended-which are not identical with those described in their text-books. This would give the students an opportunity to develop scientific attitudes and problem-solving skills.

The attached lists contain some details of the experiments carried out by the children in the last year.

List of Activities carried out by Students of Classes 6, 7 & 8

Class 6

1. Observation Exercise—to write down what students observe about simple everyday items like a fresh and a dried leaf, a rubber band, a paper clip, a pebble etc.
2. Measurement Exercises—a) using non standard units (handspans, paces).
   b) using standard units and a metre stick.
   c) Making a measuring tape (2 m long) marked off in 5 cm lengths and using it
   d) Taking a correct reading on a ruler without paral-lalax.
3. Market Survey—finding out which goods are sold by weight and which by volume.
4. a) Making of An Improvised Balance and Sandbag Weights.
   b) Discussion of errors in weighing, common malpractices.
5. a) Learning to read a thermometer.
   b) Learning to count seconds and setting up a seconds pendulum.
6. Survey of Living Things seen in the School compound.
7. Observing Forces in Action—Demonstration and discussion.
8. Measurement of Area using 1 sq.m., cut out of newspaper.

9. a) Making of an improvised bulb holder using a paper clip and insulation tape
   b) Simple electrical circuits.
   c) Testing for Conductors and Insulators.
   d) Electroplating of a razor blade—demonstration.
   e) Making an electromagnet–demonstration.
10. Using a measuring cylinder to find the volume of a stone.
11. Demonstration of the Effects of Heat.
   a) Melting of Ice. b) Rise in Temperature.
   c) Expansion.
12. Demonstration of Law of Magnetism.
13. Making a bottle compass using a sewing needle, thread and a jam jar.
14. a) Properties of a Plane Mirror Image-observed in a large size wall mirror.
   b) Writing a laterally inverted code message.
15. A study of the trees in the school garden involving.
   a) identification from clues given describing their leaves.
   b) naming the trees.
   c) fixing their location on a map (cyclostyled) of the garden.

Class 7

1. Observation of pond water and permanent slides of bread mould and algae under a microscope.
2. Children set up an experiment to observe the growth of bread mould under different conditions.
3. Learning how to make a slide
4. The Obedient Tin—which rolls back to the student (Potential and Kinetic Energy in a twisted rubber band inside the tin).
5. Demonstrations (a) Water is a Poor Conductor of Heat.
   (b) Conduction of heat through a Wire.
6. a) Making a Convection Box.
   b) Observing Convection Currents in a Spiral Snake made of paper.
7. Experiments with a Pendulum and Stop clock—observing what happens wih changes in the length of the pendulum, its amplitude and the mass of the bob.
8. Demonstration: observing and identifying Physical and Chemical changes.
9. Making and Using a Sensitive Balance, using a drinking straw and paper pans.
10 Filtration of Water to remove Impurities.
11. Demonstrations: a) The Physical Balance.
   b) The Spring Balance—
   c) Buoyancy – the loss in weight of an immersed body.
12. Demonstration: Mounting of Epidermal peel of a leaf.

Archimedes' Principle

13. Finding the loss in weight of a stone immersed in water (using a spring balance) and the volume of water it displaced (using ameasuring cylinder).
14. Demonstration: Water seeks its own level.
15. Demonstrations: a) Chlorophyll and light are needed for photosynthesis.
   b) Germination releases carbon dioxide.
16 A Balanced Diet : Crossword and Project.
17. Demonstration: Buoyancy of salt water is more than that of pure water.
18 a) Demonstration: Sound waves made by a Tuning Fork.
   b) Children made Straw Flutes.
   c) Bottles containing water arranged in order of pitch of sound produced.
   d) Producing sounds using a Wooden Flute.
   e) Varying sounds made using rubber bands—Demonstration.
   f) Slinky Spring.
19 Demonstration: Study of the parts of a dry cell.

(Contd. on page 16)

झाग ही झाग

by **Chitra Sarkar,**
Springdales School,
New Delhi

I was working with the prep class on the topic 'Myself'. When we came to discussing the cleanliness of different parts of the body, I introduced the children to a song by Madhulika Saran on keeping teeth clean titled कुच कुच कुच. The tune and the words became so popular with the class that they loved singing it over and over again, especially the repetitive line; झाग ही झाग.

One day, I casually asked if anyone knew what 'झाग' was in English. No body seemed to know, and hence a new word was added to their vocabulary. I introduced it in class and put up a flash card reading: LATHER.

On asking about the things that give us lather came a volley of answers—Colgate toothpaste, Liril soap, Pears soap, Rin, shampoo, Nirma and so on. So, a little home assignment was given to the children. They were to collect empty cartons of whatever items they could find, which give us lather. As the collections started coming in, I pinned them on to the bulletin board. Under the main heading of 'Lather', the items were sorted into groups: toothpaste, bath soaps, washing soaps, shaving cream, shampoos and liquid soaps. The children also collected advertisements pertaining to these commodities. These were finally combined into a large colourful chart.

Other activities followed. One day, we decided to make some soap lather and wash dirty handkerchiefs and napkins. Some children dried their materials in the sun, while others put them in the shade. The children observed for themselves that the clothes put out in the sun dried faster.

We made a soap solution and blew into it with a straw to make bubbles. It was fun trying to make the biggest bubble and to watch the colours of the rainbow in the bubble.

We also discovered that no lather could be made without water and this eventually took us further afield to work on the subject of 'Water'.

FISHES

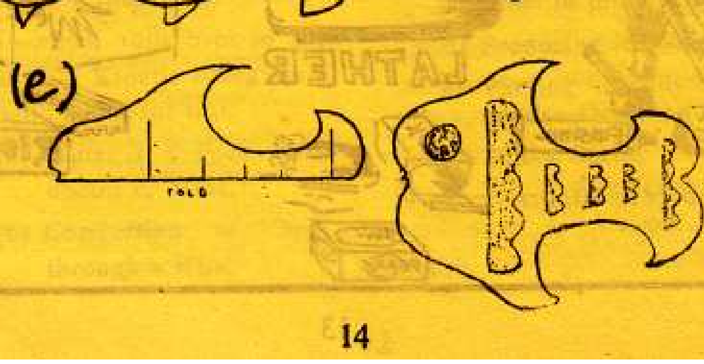
Fishes are popular subjects in classroom decoration. Modified in many ways for inventive fingers, they can be displayed in friezes, mobiles, models and patterns. Here are some interesting variations.

a. A simple cut-out, textured or coloured, it can be mounted flat or with the form raised as suggested. Allow colour and texture to be a free choice by the children. Provide paint, crayons, tissue paper circles and scraps to glue on as blobs. Use seeds, buttons and bottle tops too.

Young children will need a template, and the fish should be as large as possible.

b. This simple shape, textured and cut out of a dark—toned paper should be mounted against the light, with cellophane or tissue glued behind. It makes an impressive display. Pieces of wool or paper can give a fancy edge to a paper fish.

c. Using a simple outline, cut the fish into pieces and fix to a suitable background. Do not to add or take away any pieces. Fun at any age.

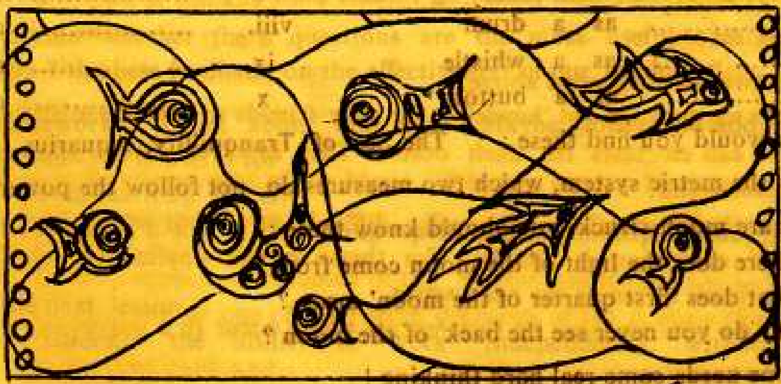


d. Infant writing patterns can be turned into fish and used as borders on book covers and mats.

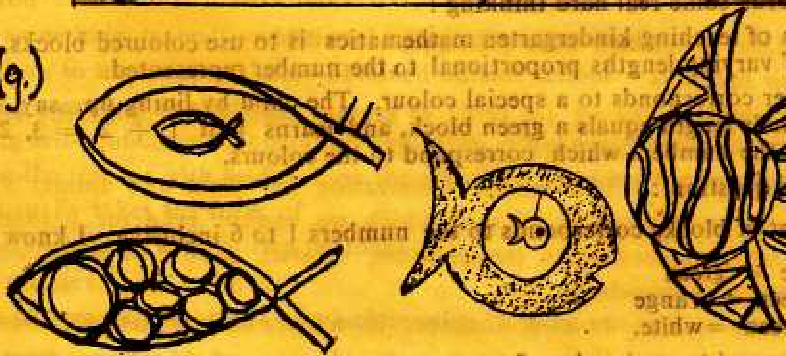
e. Fish made to a fold, with or without a template, can have inserts of foil, tissue, ribbon or straws. The fish may be mounted or hung.

Two identical pieces glued round the edges make a mobile fish, Cellophane or tissue can be sandwiched in the middle. Pull it taut when fixing.

(f.)



(g.)



f. Fish can also be made of string glued to a card base.

g. Fish for attractive mobiles are easily made using strips of coloured paper. The form of the fish is made first, and the outline filled in with loops, folds and whorls. The larger the fish the better. Small fish can hang inside larger ones.

(Adapted from Infant Crafts for School and Home by Margaret Norton.)

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QUIZTIME

The "in" things today—especially in our television programmes are quizzes. So put on your thinking caps and see how quickly you can solve these.

1. Let's start with something simple for the teachers of the English language. There are many *'as a'* expressions in the language. Some last a long time; others become outmoded and forgotten—in fact, "as dead as a dodo". How many of the following can you complete ?

i. .... as a pig		vi.	as life
ii. .... as a needle		vii.	as day
iii. .... as a drum		viii.	as toast
iv. .... as a whistle		ix.	as gold
v. .... as a button		x	as night

2. Where would you find these : The Sea of Tranquillity, Aquarius

3. Under the metric system, which two measures do not follow the power-of-ten rule ?

4. If you are moon-struck, you should know these :
   i. Where does the light of the moon come from ?
   ii. What does 'first quarter of the moon' mean ?
   iii. Why do you never see the back of the moon ?

5. This one needs some real hard thinking !

One system of teaching kindergarten mathematics is to use coloured blocks, each of the same cross-section, but of varying lengths proportional to the number represented.

Each number corresponds to a special colour. The child by lining up, say, a red block and a blue block, finds their length equals a green block, and learns that $1 + 2 = 3$, $2 + 4 = 6$, and so on, depending on the numbers which correspond to the colours.

Here's your question :

A certain set of blocks corresponds to the numbers 1 to 6 inclusive. I know that :

red + blue = green
blue + green = orange
black + green = white.

What numbers correspond to each colour ?

(Answer on page 19)

(Contd. from page 12)

Class 8

1. The Catapult or Rubber Band Gun—the action/reaction principle.
2. Observing a candle and recording as many facts about it as you can observe.
3. Children made a model to show the Phases of the Moon.
4. Demonstration :
   a) The Preparation of Hydrogen.
   b) Comparison of action of Hydrogen and oxygen on a glowing splint.
5. Using litmus paper to detect acids from given liquids.
6. Using indicators (litmus, turmeric, phenolphthalein) to identify acids and alkalies.
7. Studying the parts of a candle flame.
8. Demonstration of chemical reactions :- neutralisation, double decomposition: Recording of changes observed and writing equations.
9. Cooling/Heating Curve for Wax/Naphthalene.
10 Multiple Reflections—arranging mirrors to see around a brick.
11. Properties of the image formed by a plane mirror-writing of laterally inverted message.
12. Demonstration :
   a) Images formed by a Concave mirror.
   b) Images formed by a Convex Lens.

Homework

—Something To Think About

Homework is such an integral part of our teaching routine that we often do not stop to think about it. A lesson is finished "Children, please do all the exercises at the end of the chapter and submit your notebooks tomorrow."

Have we analysed whether these questions are the most useful ones? the best way of recapitulating the lesson ? the best feedback on the effectiveness of our teaching ?

Why give homework ? Think about that first Maybe you could add something to the points given below. Homework is useful for

* revision of classroom learning (facts)
* practice of skills learnt in a school (including spelling drills, multiplication, geometrical constructions etc.)
* preparing for the next lesson
* developing in students the ability to work independently, without direct/indirect supervision
* learning something 'extra"—additional information, new skills
* learning how to use local resources obtained outside school
* developing creativity in students
* promoting self-confidence, cooperation and many other social skills in students
* providing the teacher with feedback on the effectiveness of his/her teaching strategies.

Homework usually takes the form of

* reading—followed by oral/written feedback
* written exercises
* activities of many kinds—most of which involve "finding out"

The teacher must consider his/her own objectives clearly.

* **How much has actually to be memorised ?** Certainly, definitions and statements of laws, which help students gain valuable marks in tests, are to be learnt by heart. Likewise multiplitables learnt well lead to speed in computation. But **mere learning by rote hinders self-expression and stifles creativity.**

* How can an element of novety be put into the assignment ? Can we reduce the drudgery and boredom of the students ? **Can they have fun and still learn ?**

Here are some ideas—general ones, which you might like to try out in your own subject.

A : Vocabulary Development

i. Find spelling errors in a given list of words.
ii. Practice using the dictionary to find the meanings of given words.
iii. Use a Thesaurus to find synonyms.
iv. Use a 'Word Power' type quiz (refer to any issue of the Reader's Digest, if you need a sample)—to check on understanding of new words.
Can students make up such quizzes for each other ?
v. Crosswords can be used successfully to test knowledge and understanding of technical words/definitions and simple facts
Try giving the completed crossword and get children to make up clues.

vi. Locate words hidden in a 'word square'.
Even young children enjoy making up these squares.

vii. Try word building and word chain games.

viii. Find rhyming words.

ix. Get children to write limericks/poetry.

x. Let children look for a pattern in words—eg; the names of chemical compounds follow certain simple rules which indicate their structure; parts of the human body have certain adjectives associated with them—eg cardiac (heart), pulmonary (lungs) and so on.

B. Checking Facts

i. Use crosswords-mentioned above.

ii. Get chiloren to write out 'howlers' for their friends to find the mistakes.

iii. Children can set 'tests' for each other. This involves careful learning and checking up on facts beforehand.

iv. Multiple-choice questions are usually difficult to set but worth the trouble. Children enjoy them and correction is simple. Use them to test application also Build up your own question bank to use as the need arises.

v. Use a Time Line to check on facts/events which occur in a sequence.

C. Using Local Resouvces

i. People—find out about their lives (history!)
—their opinions
Teaches the children the art (or skill) of asking questions, conducting surveys, recording results in tabular form, drawing conclusions.

ii. Gardens—develop skills like careful observation (of plant and animal life), recording (in words/pictures), map reading (a skill which we cannot take for granted), questioning, setting up simple experiments (temperature, rainfall, growth of plants, animal habits etc), applying theoretical knowledge.

iii. Buildings can be used to develop concepts in science and mathematics; historical buildings can make the past come alive.

iv. Newspapers an excellent source of data :
—weather reports, prices, advertisements...... .....
—"quotable quotes" and "blunders"
—interesting descriptions, narratives, interviews.

v. Scrap Material can be used.
—for art and craft work.
—to make working models in science and social studies. Much learning goes into the process of trying, failing and trying again !
—for "dressing up"—pretending you lived long ago—for your costume and props for the story/scene to be enacted. Young children would enjoy this thoroughly.

Activities of this kind can sometimes be given to groups, thereby providing them with opportunities of working together and learning valuable lessons in cooperation.

Activities done outside school hours do not suffer from any constraints of time, leaving children free to explore many new avenues. Some of the skills learnt are those which we have no time to impart during working hours—which are, however, essential to life in the modern world.

Answers to Quiztime

Let's start at the very beginning ... a very good place to start !

1.
- i. as fat as a pig
- ii. as sharp as a needle
- iii. as tight as a drum
- iv. as clean as a whistle
- v. as bright as a button
- vi. as large as life
- vii. as clear as day
- viii. as warm as toast
- ix. as good as gold
- x. as black as night

2. The Sea of Tranquillity is an area of the Moon. The first human landing on the moon took place there.

Aquarius (apart from astrological columns of the Sunday newspapers) is to be found in the sky. It is one of the constellations, or one of the twelve divisions of the ecliptic (find out what that means on your own !).

3. Time — 60 seconds in a minute and 60 minutes in an hour
Angles — 90 degrees in a right angle.

4. i. Moonlight is a reflection of the sun's light. The moon is cold and produces no light of its own.

ii. 'First quarter' is one quarter of the way from one new moon to the next.

iii. The moon rotates on its own axis at the same speed as it rotates around the earth (roughly once in 28 days). Hence the same face of the moon is always pointing towards the earth.

5. From the first two relationships, we know that red + blue + blue= orange.

If blue represents 3 or more, orange must become a number greater than 6, which is not possible. Therefore blue is 1 or 2.

If blue = 1, red can be 2 or 3 or 4, but no higher number. If blue = 2, red must be 1. Otherwise blue or red represent the same number, or orange is more than 7— both of which are not possible.

We can now write down a table of possible solutions :

	Blue	*Red*	*Green*	*Orange*	*Black*	*White*
A.	1	2	3	4	impossible	
B.	1	3	4	5	2	6
C.	1	4	5	6	impossible	
D.	2	1	3	5	impossible	

The only possible solution is B.

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